Maney Publishing
Research • Knowledge • Innovation

THE COPYRIGHT FORM

To enable Maney to publish your article, please return a hand-signed Assignment of Copyright form (see attached in email) within **5 working days** to jrl@maneypublishing.com. This is essential as your work cannot be published without a signed form.

YOUR ARTICLE

Please review the proof* of your article carefully, checking for any final typographical errors or minor necessary updates. Please address and answer in full any queries which the copyeditor may have raised on the Author Query sheet accompanying your proofs.

Please make clear any necessary corrections, within **5 working days**, using one of the following methods:

- Use Adobe's Comments and/or Editing Tools to indicate changes directly onto the PDF and return via email. Please request guidelines if required.
- Email the necessary corrections as a list citing the page and line number where a correction needs to be made, how the text currently appears, and what it should be changed to.
- Use the BSI proof marks to indicate changes on a paper printout of the PDF and email, the pages (contact details below).

Krista Cowman and Ian Packer,
Journal Editors
kcowman@lincoln.ac.uk; ipacker@lincoln.ac.uk

VIEWING YOUR ARTICLE'S PRODUCTION STATUS AND PLACING ORDERS USING MANEYTRACK

http://maneytrack.maney.co.uk

Approximately three weeks ago, you will have received an email detailing your log-in details for Maney Publishing's web-based production tracking system, ManeyTrack. Via ManeyTrack you can:

- View the production status of your article at any time.
- Place orders for printed colour, offprints, issue copies, or to make your article open access.

Please log in using the web address, above. If you have misplaced your log-in details please check your spam/junk folder. If you are still unable to find them please click on the above url and click on 'Forgot Password' and follow instructions. If you require further technical assistance, please contact the Administrator: ManeyTrackAdmin@maneypublishing.com

ADDITIONAL INFORMATION

This journal is hosted online at www.maneyonline.com/jrl
OPEN ACCESS (MORE OpenChoice): Should you wish to make your article freely available online (open access) please log in to ManeyTrack to view prices and to place your order – see details for ManeyTrack above. For more information regarding Maney's open access product, MORE OpenChoice, please see: www.maneyonline.com/openaccess
OFFPRINTS: You will receive a complimentary PDF eprint of your final article. If you wish to purchase traditional hardcopy offprints please log in to ManeyTrack to view prices and to place your order – see details for ManeyTrack above.
ISSUE COPIES: You will have the opportunity to purchase a copy or copies of the issue your article will be published in at the time you receive the final PDF (eprint) of your article. Details stating how to order will be included in the eprint email.
PRINTED COLOUR: All figures supplied as such will be reproduced online in colour free of charge. If you would like colour figures reproduced in the printed version please log in to ManeyTrack to view prices and to place your order – see details for ManeyTrack above.

GET FOUND, GET READ, GET CITED

As part of our commitment to making the content we publish as visible as possible, Maney offers its authors use of the Kudos service which is designed to help you increase article readership and citations by enabling you to explain, enrich and share your articles. Corresponding authors will receive a registration email regarding the service once the article is published. To find out more visit www.growkudos.com.

FEEDBACK

Tell us about your publishing experience at:
https://www.surveymonkey.com/s/HSS_survey

***Please note this PDF file may not be offered for commercial sale or for any systematic external distribution by a third party.**

Kind regards,
Production Editor

INTERNATIONAL JOURNAL OF REGIONAL AND LOCAL HISTORY,
Vol. 10 No. 1, May, 2015, 1–16

Newton and the Apothecary

ANNA MARIE ROOS
University of Lincoln, UK

The Grantham Corporation Minute Books and inventories from the apothecary shop of Ralph and William Clarke are analysed to illuminate neglected aspects of the life and letters of Sir Isaac Newton, particularly the influence of Lincolnshire social and intellectual networks. The article also examines the nature of rural health provision in early modern Grantham.

KEYWORDS Sir Isaac Newton, William Clarke, Ralph Clarke, Grantham, apothecary, *materia medica*

After his tenure as a pupil at the King's School, Sir Isaac Newton attended grammar school in Grantham from 1654 to 1660. First mentioned in 1327, the school building was constructed in 1427, and endowed by Bishop Richard Foxe in 1528 as The Free Grammar School of Edward VI. During his time in Grantham, Newton lodged with William Clarke, a Grantham apothecary, and prominent local politician, who served as comburgess, alderman, and coroner. Although the life and letters of Sir Isaac Newton have been subject to numerous historical analyses, both written and digital, his childhood biography has tended to be psycho-historical, hagiographic, or didactic.[1]

There has also been little consideration to what extent Lincolnshire, whether its literal or geographical landscape, had upon Newton's intellectual development. On the one hand, studies of early modern intellectual history posit that scholars were united by intellectual rather than by geographical centres of gravity, often through the epistolary network of the Republic of Letters.[2] On the other, approaches to Newton's life and letters have been heavily Cambridge and London-centric, overshadowing other influences which have been characterized as provincial. Consider this extract from Richard Westfall's *Never at Rest*, still considered the standard for Newtonian biography, describing when Newton was about ready to start at Cambridge:

> Let us try to place ourselves in the position of a young man in 1661, eager for knowledge . . . as the new world of learning unrolled itself before his eyes. What an incredible challenge to the imagination – a world undreamed of in rural Lincolnshire.[3]

To be fair, Westfall does pay due obeisance to Newton's 1666 *annus mirabilis* at the family farm in Woolsthorpe, Lincolnshire, and antiquary William Stukeley's account of the apple's fall and gravity in his *Memoirs of Newton* (1754) is dominant

 DOI 10.1179/2051453015Z.00000000022

in the historical narrative. But the apple fall seems more a function of the archetypal "Eureka" story, which only makes sense if "discovery" is construed "rather narrowly as concerned with the eureka moment, i.e. the time when a new idea or conception first dawns".[4] And, even this particular element of Stukeley's memoirs must be approached with caution and put into historical context. Historian Simon Schaffer has noted, for instance, that "the historical record reveals that until the mid-1680s, Newton never developed a concept of universal gravitation and stayed firmly wedded to Cartesian models" of planetary motions in which fine-particled ethers in the atmosphere moved the planets in their orbits. Schaffer continues, "Only in 1684 did he finally invent the term 'centripetal force' to describe the action pulling bodies towards their orbits' centres".[5] We also have to remember that by 1797, Newton's heirs institutionalized Stukeley's story to establish his reputation as a precocious genius.

So it seems long overdue to consider some recently discovered and some neglected sources from local history that can not only corroborate some of Stukeley's accounts of Newton's Lincolnshire childhood (if not the apple story) but also can demonstrate how the circumstances of Newton's rural upbringing was seminal to the cultivation of his imagination and to his later scientific discoveries. In collaboration with Professor Rob Iliffe, local historian John Manterfield has offered new insights into the Newton's early years in his reconstruction of the local political and social milieu of Newton's Grantham using the Grantham Corporation Minute Book 1649-62 (known as the Hall Book); Manterfield emphasized the Parliamentarian Clarke's aims of establishing an individual self-governing community which modelled the wider Puritan Commonwealth.[6] It is interesting to speculate, for instance, that exposure to religious dissent may have influenced Newton's later religious radicalism as an Anti-Trinitarian. In a separate, and much older study, Manterfield also did a short preliminary and primarily empirical analysis of Ralph Clarke's and his son William's apothecary shop inventories, which are housed in the Lincolnshire Archives.[7]

Using these sources, as well as Stukeley's *Memoirs,* this paper will analyse the possible influence of Clarke not upon Newton's religious or political views, but upon his intellectual development and early life. We will focus upon Newton's exposure to the apothecary's art, which we argue represented a distinctive opportunity for him to engage upon an extended period of experimental practice and inquiry that served him well in his later work, particularly in chemistry. At the same time, our examination of Clarke's shop also illuminates the nature of health provision in Grantham, and the history of rural health care more generally, which as a special issue of this journal has reminded us, has "largely been informed by urban perspectives".[8]

Newton's Lincolnshire Education in Historical Context

Several historians have indicated that Newton received an exceptional education at the King's School, but less explored is the degree to which this was due to historical circumstance. From 1625–30, there were more graduates from the University of Cambridge than ever before, the level not attained for another two hundred years. Elizabeth Leedham-Green indicated:

> the number of matriculations at Cambridge in 1619 amounted to 509. Except in 1631 and 1667, when those who had been prevented by plague from matriculating in the previous year were also entered, this figure was not to be equaled until 1864.[9]

As a result, "there were few avenues of employment open to these university trained men except minor offices in the church or teaching".[10] Robert Burton, a Leicestershire native, lamented the scholar's lot in his *Anatomy of Melancholy*:

> What course shall he take, being now capable and ready? The most parable and easy, and about which many are employed, is to teach a school, turn lecturer or curate, and for that he shall have a falconer's wages, ten pound per annum and his diet, or some small stipend, so long as he can please his patrons or the parish.[11]

The overabundance of applicants for teaching positions did mean that the quality of instruction Newton received would have been exceptional, particularly under the tutelage of Mr Henry Stokes. Stokes was a Melton Mowbray native, the eldest son of a local blacksmith, his intellectual gifts leading him to be admitted as a sizar of Pembroke Hall, Cambridge, receiving his B.A. in 1642/3.[12] In 1649, Stokes moved to be master of Grantham School in Lincolnshire. The Grantham Hall Book for 1649/50 indicated:

> Att this Court it was taken into consideracion the want of a Head-Schoole-Master for the Free Schoole of this Corporacion, and being informed that Mr Stokes the School-Master of Melton is a very able & sufficient Man every way qualified for the takeing upon him of such a Charge. And this Court likewise takeing into Consideracion that there are Many Knightes & gentlemen of Qualitie neare about us that would send their Children to a free Schoole if it were furnished & provided of an able Man for teaching, whoe now send them to other places for want of a sufficient Man here amongest us And being informed that the said Mr Stokes, hath beene conferred with all and acquainted him to come to be our schoole Master if he bee invited & chosen thereunto by a free & generall Consent of this Corporacion, which this Court takeing into serious Consideracion & weighing the great Benefitt & good that would redound & come to the Common-wealth in generall by the well educateing & traineing upp of Children in learning & pietie & the benefitt & profitt to this towne in particuler by the enjoyment of an able Schoole Master of this Schoole, Doe make choyce of the said Mr Stokes to be Schoole Master of the free Schoole of this Corporacion upon the same Condicions that Mr Wilkinson late Schoole Master here … And that he shall have the Sallary of xx li per Annum payed him quarterly by this Corporacion as Mr Wilkinson hadd att the tyme of his Death, and alsoe the xx nobles per Annum from Corpus Christi Colledge in Oxford with possession of the house belonging to the Schoole withall profettes and emolumentes thereunto appertaining as the Schoole-Masteres of this Free Schole have auncyently had And it is further Agreed that the said Mr Stokes be sent unto & made acquainted with this eleccion, & to desire him with all convenient speed to come and take the Charge upon him & to settle amongest us.[13]

Stokes' effectiveness as schoolmaster was confirmed the following year, as the 1650/1 Hall Book noted:

> Att this Court came in Mr Stokes Schoole-Master and desired the Approbacion & Confirmacion of this Court for his further continuance in the place & office of Schoole Master whereunto this Court withall cherefullnes condiscended and by a generall Consent he is confirmed Schoole-Master of the Free-schoole of this Borrough for his life, if noe cause to the contrary shall hereafter appeare.[14]

As is well known, it was Stokes's intervention with Newton's mother Hannah, which assured the young man went to study in Cambridge rather than being confined to managing Woolsthorpe, the family's Lincolnshire farm. As indication of the esteem in which Stokes was held, he voluntarily resigned Grantham School in December 1663, going to Melton Mowbray School where he was made master for life at a salary of £40. He was also given a house free from taxes (taxes were approximately one-quarter of the salary) and free from the quarter of soldiers.[15] Certainly from the salary offer, which doubled what he received at Grantham, it seems that Stokes was, as contemporary William Stukeley stated, "reputed to be a very good scholar, & an excellent schoolmaster".[16]

Stokes would have followed a traditional curriculum, teaching Newton and his other classmates how to read, write, and speak Latin. They would have introduced their pupils to the poetry of the ancients, theology, and taught some Greek and Hebrew. Newton would also have learned the composition of Greek and Latin verse, epigrams, and expository essays on oratorical themes, and how to keep a commonplace book of useful phrases and rhetorical tropes and figures to ornament his prose. His habit of keeping a notebook to record snippets from his reading and field observations was formed early, and in general, early modern natural philosophers employed notebooks just as much, if not more so than their humanist predecessors.[17] The virtuosi still had the humanist impulse to relieve and prompt memory, but they experimented not only with elements of the natural world, but with new ways of organizing and recalling information. In so doing, they invented the laboratory notebook, and Newton kept many notebooks, as a student and throughout his obsessively productive career. His notebook keeping was a product of his humanist education at grammar school.

More importantly, Newton was also inculcated with principles of religion, good behaviour, and civility; admission registers to Cambridge often recorded pupils were "bred" at their grammar schools after all, the implication being that his long education molded and transformed his character positively and thoroughly. As Keith Thomas indicated, it was thought:

> the job could best be done by what the French historians call *scolarisation*, taking education out of the household, segregating the young from the influence of their homes; of women; of their less fortunate contemporaries (for grammar schoolboys were warned to avoid "needless" association with "apprentices and idle boys"); and even of the vernacular, for in most grammar schools the older pupils were supposed to speak Latin at all times, both in and out of school.[18]

As part of this "proper breeding" the teaching of Latin, in the words of Walter Ong, was indeed a "puberty rite, designed to provide selected youths with a painful initiation into socially reputable but essentially non-functional mysteries".[19] In addition to the disciplining of the mind that learning Latin entailed, it is evident that Newton learned his lessons in languages well, for the Latin style in his later

scientific works is exceptional and thoroughly peppered with references to the classics in the original Greek.

In addition to these humanist disciplines, Stokes added some practical arithmetic to the Grantham curriculum for his prospective farmers and landowners. His lessons were comprised:

> mostly about measurement of areas and shapes, algorithms for surveying, marking fields by the chain, calculating acreage (though the acre still varied from one county to the next, or according to the land's richness).[20]

Stokes also offered more than a farmer would need: "how to inscribe regular polygons in a circle and compute the length of each side, as Archimedes had done to estimate pi".[21] We can speculate that the schoolmaster's efforts worked their magic on Newton; astronomer Arthur Storer was also one of Stokes's pupils and he and Newton both lived in the Clarke's household. Storer's mother was Katharine Babington, who was first married to Edward Storer, and upon his decease in 1645, married apothecary William Clarke. In his MS "Fitzwilliam Notebook" he kept as a youth, Newton reported beating Storer in a schoolboy scuffle.[22]

The Role of the Apothecary's Shop in Newton's Intellectual Development:

So, Newton's education did not end at the schoolhouse, but was influenced by where he lodged, something indicated by William Stukeley's *Memoirs of Newton*. Stukeley (1687–1765) was Newton's friend, a fellow of the Royal Society and of the Spalding Gentleman's Society, and a practising physician in Boston, Lincolnshire. Stukeley wrote:

> whilst Sir Isaac was at Grantham School, he boarded at Mr Clarks house, an apothecary, grand father to the present Mr Clark, now living. 'twas the next house to the George inn northward, in highstreet: which was rebuilt about anno 1700.[23]

The Mr Clark to which Stukeley referred was of course, William Clarke, the town apothecary and one of the most powerful parliamentarian figures in Grantham. As Manterfield has indicated, in the period of the Protectorate, Clarke became the leading freeholder in Grantham, serving as Alderman and Comburgess.[24] Why in particular did Newton stay with Clarke? Stukeley tells us that Mr Clarke's second
2 wife Katherine, formerly Storey was a "great intimate" of Newton's mother, which was "one reason of his lodging at Mr Clarks". It is just possible that the association between the Newtons and Clarkes had also extended back another generation. William Clarke's father Ralph, another apothecary, served as an appraiser to the will for mercer Christopher Fisher dated 6 and 9 February 1597.[25] One of the other appraisers for Fisher was named Humphrey Newton. Although no Humphrey Newton appears in Newton's own account of his ancestors, Humphrey may have been a distant relative, as Newton's own account of his pedigree was incomplete at best. Indeed, Stukeley indicates when searching for Newton's ancestry:

> Mr Ralf Clark, apothecary at Grantham (with whose grandfather Sir Isaac had lodged when a schoolboy) & I, were busy at Mr Mason's rector of Colsterworth, in our

> inquirys; when the Express came by post, going to Scotland, of the death of King George I. I made diligent search for the Registers of the parish, of births, buryals, & marriages: especially the older ones, which generally have been very ill kept. nor can we say much in commendation of those of more modern date. they commonly give us the bare name of persons, without father, mother, or such other marks, as ascertain the identity of person. the old ones for the most part are lost, destroyd, or obliterated; for want of care, & due preservation.[26]

In his account of Newton's childhood, Stukeley also mentioned "Dr Clark MD, brother to Mr Clark, with whom the lad boarded, was usher to the school, at that time".[27] This was a half-brother of William Clarke, "almost certainly the Joseph, son of Ralph Clarke of Grantham, admitted to Christ's College, Cambridge . . . in 1645".[28] Joseph Clarke indeed made his appearance in the Hall Books as usher or second schoolmaster, a post he held until his resignation in August 1662, whereupon in a typical early modern act of nepotism, Edward Stokes, brother of Henry Stokes, replaced him:

> At this Court came Mr Joseph Clarke the Under Schoole Master and returned Mr Alderman and this Court many thankes for their favours and respects to him and acquainted them that his occassions was very urgent and he could not attend the place of a Schoole Master as heretofore he had done . . . Whereas Mr Henry Stoakes the Head Schoole Maister this day after Mr Joseph Clarks request graunted, mocioned Mr Edward Stoakes his Brother to this Court and desired likewise that they would please to accept of him to be Usher.[29]

Stukeley also indicated that Joseph Clark "had been pupil to the famous Dr. Henry
3 Moor [More] of Christs college, Cambridg".[30] The Neoplatonic philosopher Henry More wrote works on matter theory, the nature of space, and its relation to God, engaging in several debates with the materialist philosopher Thomas Hobbes. Although it is not known to what extent Joseph Clark would have influenced Newton's education, Edward Grant and J.E. Power have speculated that More's arguments for the geometrization of spirit and for infinite space may have influenced Newton's concept of absolute space.[31]

The physical space of the Clarkes' shop also influenced Newton's developing intellectual interests. London "inventories indicate that many apothecaries lived in the same building as their shop, in the upper levels of the narrow three- or four-storey houses that were characteristic of the better city street".[32] The Clarkes' shop was no exception. Inventories of the family shop, for example, listed goods for sale alongside descriptions of the furnishing of rooms "in the hall", "in the light parlour", "in the dark parlour,", in the "New Chamber", the "strayt chamber", "Buttrie", and "kytchin".[33] There probably was also a back room behind the counter to do simple distillations and to roll pills. We also notice listings of a wide variety of products for sale: haberdashery including silk "Lancashire cloths", "Cambrick", "tafyta hattes" felts, and spices (pepper, cinnamon, nutmegs, mace) and groceries.[34] Of course, apothecaries did sell products that were not drugs, and there was no firm boundary between their products and the wider range of commodities sold by many grocers and merchants. The multiple applications of many drugs as dyes, flavourings, and artists' pigments blurred matters further.

As Patrick Wallis indicated, by the mid-seventeenth century, apothecaries' shops had become highly stylized and distinctive.[35] Systematically arranged ceramic and glass jars were placed on organizing units, and jars and vials of coloured waters were often set out so passers by could see them from the street. Some historians have indicated that the extensive shelving of the apothecaries' shops, displaying exotic specimens and substances of *materia medica* may have influenced the ordering of cabinets in the early modern museum, also developing in the sixteenth and seventeenth centuries.

> Apothecaries invested an unusually high proportion of the value of their shops in fixtures, fittings, and processing equipment. Although they did not need a particularly high initial capital investment, requiring only £50–£200 to set themselves up, they tied up an average of nearly 40 per cent of the total value of shops in fixtures and fittings.[36]

The practicalities of manufacture, and equipment explained some of the cost, but a significant element of the expense was due to their investment in display and decoration, particularly the ceramic jars or gallypots with their majolica glaze, a resistant surface.

> Majolica jars had been imported to England since the fifteenth century, coming initially from Italy, where they were first made in this form. A domestic manufacturing industry in the provinces and in London developed from the mid-sixteenth century, as immigrants from France and the Netherlands imported the new technique.[37]

We see this in one of the earliest extant English representations of an apothecary's shop: a panel in the frontispiece by William Fairthorne in *The expert doctors dispensatory* (1657), Nicholas Culpeper's translation of the Montpellier physician Pierre Morel's *Methodus praescribendi formulas remediorum*.

Along with the traditional herbal purges and emetics employed to restore
4 humoral balance inthebalance, we also see due to the influence of Paracelsian medicine the use of what we would consider quite dangerous substances in medicine, such as mercury to treat syphilis (which does kill the spirochete responsible), but also can lead to bone loss and slobbering. The Clarkes' inventories indicate they possessed "quicksilver conserve"[38]; mercurial pills were made by triturating the mercury with a conserve of red roses in mortar until the mercury globules disappeared; liquorice (also listed in the inventories) or some mucilage of gum arabic and starch were added to make a mass from which the pills were rolled.[39] Antimony was another favourite; a very toxic metal, it was shaped in a cup in which wine was poured. The wine would take up the poison, and it was a
5 powerful vomit. Antimony crystallises in a star or regulus shape, and the high toxicity of antimonial cups was thought to be due with their affinity with the literal star regulus in the constellation of Leo, which was impregnating the cup via effluvia with its power. So, we see that astrological medicine and thus astronomy were also important for the apothecary to know, as astrology, particularly lunar phases, governed when the patient was bled or purged. Indeed, Newton's undergraduate Trinity Notebook (*ca.* 1661–65) shows that he was au fait with regulus of antimony compounds to make mirrors or "metall for reflections", and that in his

exploration of the nature of colour, he was experimenting with antimony and other compounds to observe colour changes in chemical reactions.[40]

An apothecary's apprenticeship training included herborizing in "physick" or medicinal gardens and learning techniques necessary to prepare medicines, including fermentation and distillation. He had to be skilful at extracting essences from natural products and compounding them into medicines. Apprentice apothecaries also had to learn Latin to follow the *Pharmacopoeia Londinensis*. They also perused Pliny the Elder's (23–79 AD) *Natural History,* a vast reference work that continued to be widely disseminated until the seventeenth century. Pliny discussed natural medicines that were cheap and simple to create, promoting Roman values of hard work and self-care. Another influential work was that of Pedanus Dioscorides (circa 40–90 AD) whose *De Materia Medica* was a precursor to modern pharmacopeias. As the work of Valentina Pugliano has shown, early modern

> pharmacy contributed some of the essential material practices that sustained the running of natural history, from the methodical training of the senses for fieldwork and workshop experiments to techniques to preserve specimens and collectables and transport them safely.[41]

So, apothecaries were chemists, and they were natural historians, identifying and transforming the raw *materia medica* into drugs. In fact, as Hal Cook has argued, since the late fifteenth century, physicians had:

> been in the forefront of learned attacks on scholastic and Aristotelian philosophy in favor of more empirical, natural historical knowledge useful for curing; An understanding of plants, animals and minerals would provide a learned foundation upon which to build a knowledge of the "virtues" of specific drugs.[42]

It was thus also rather common for medical students to lodge with apothecaries, where, for example, they would learn by informal instruction the names and preparation of particular drugs from botanics and chemicals.[43] These informal observations would be in addition to the more structured and theoretical education they would receive in lectures, as the study of the chemical and botanical pharmacopoeia and the study of medicine were inseparable at this time. In France, particularly in towns noted for their medical schools, there were a profusion of apothecaries who offered private lessons to aspiring medics. When visiting Montpellier in the 1660s, the botanist John Ray noted, to his great surprise, that there were thirty apothecary shops within the town walls, and yet "all find something to do".[44] In England, a number of apothecaries' shops also served as sites for natural philosophical experimentation and discussion. In the 1650s, for example, Robert Hooke designed the air pump and Robert Boyle carried out his experiments with it in the apothecary John Crosse's shop in Oxford.[45]

So, Newton, by staying with the Clarke family, not only received a formal grammar school education, but also was exposed in some fashion to the mysteries of botany and chemistry, much as a medical student would be. Although it is now well known that he performed extensive (al)chemical work at Trinity College from 1669 until 1695, it is certainly interesting to speculate to what extent his interests in

these things were spawned by lodging with an apothecary and observing the making of medicaments.[46] In fact, in his memoirs of Newton, Stukeley wrote that one Mrs Vincent, whose mother was William Clarke's second wife:

> told me likewise, [Newton] was very curious in gathering herbs, which we call simpling. Probably he might learn this from the prentices of the shop, where he lodg'd. tho' doubtless, he had inclination enough of his own, for every branch of natural knowledg.[47]

6

Stukeley continued:

> Sir Isaac who was so fond of plants, undoubtedly has often contemplated thir delicate purple, with yellow pointils. nor has the golden asphodel here growing escap'd his notice; nor the magic lunaria minor moonwort. the flower of bean trefoil, that extraordinary beauty, growing in bogs here, by the side of springs.[48]

Apart from their intrinsic botanical interest, many of these plants were quite common herbal medicaments. Bean trefoil or buckbean, a gentian plant (*Menanthes trifoliata L.*) is often wrongly described in sixteenth- and seventeenth-century books on herbs as bog bean or water trefoil (*Trifolium fibrinum*).[49] Its centuries of use have generated a rather long list of herbal and folk medicine applications; its primary use today is as a water garden ornamental. Buckbean is widespread in the marsh flats of Lincolnshire, and is an intensely bitter herb that helps to promote appetite as well as invigorates the secretion of digestive juices; it is also used to combat fever and worms.[50] This herb is generally taken to enhance a weak or dysfunctional digestion, especially if the patient also experiences uneasiness in the abdominal region.

Moonwort, or *lunaria annua* is commonly known as honesty, with white and red-violet flowers, and silvery seedpods thought to resemble the moon. Nicholas Culpeper, the renowned seventeenth-century herbalist, also describes its magical qualities:

> (Moonwort) will open locks, and unshoe such horses as tread upon it … I have heard commanders say, that on White Down in Devonshire, near Tiverton, there were found thirty horse shoes, pulled off from the feet of the Earl of Essex's horses, being there drawn up in a body, many of them being but newly shod, and no reason known, which caused much admiration: the herb described usually grows upon heaths.[51]

According to the Paracelsian Doctrine of Signs, Moonwort cured lunacy, epilepsy, and sleepwalking, all associated with the phases of the moon. In early modern England, the medical effects of the sun and the moon had been traditionally explained by a vast symbolic system of "analogies, correspondences, and relations among apparently discrete elements in man and the universe", which had its conceptual origins in the works of Aristotle, Ptolemy, and Galen.[52] *Astronodia* was the belief attributed to Hippocrates that the presence of the moon in different signs of the zodiac influenced the humoral content of various parts of the body.[53] It was thought that the moon regulated the fluids in the body, much as it regulated the tides, and so its phases would control the occurrence of diseases like epilepsy, the menstrual cycle, and the swelling or retraction of fluid filled tumours, like those of scrofula or lymphatic tuberculosis.[54] The Galenic corpus for example, advised that the waxing and waning of the moon controlled not only the volume of blood in

the body, but also the amount of cold and moist phlegm in the brain. An abundance of phlegm was thought to cause fits in epileptics and madness.[55]

This plant was also thought by alchemists to have the ability to turn mercury or quicksilver into silver, the silver moon related to the plant's shape and the silver metal. As alchemists often used analogical language, the term *lunaria* could also refer a "philosophical spirit of wine" or particular herbs distilled in ethanol, a substance thought efficacious in making what was known as the philosophical mercury, necessary to transmute matter.[56] Newton, later in his career, compiled an *Index Chemicus*, Keynes MS 30, an elaborate alphabetical index and reference guide to the literature of alchemy. In it, he referred to: "*Lunaria herba in montis vertice crescit radice nigra, caule rubro, floribus splendentibus albis et rubris. Theat. Britan.* p 349".[57] Newton was referring to Elias Ashmole's *Theatricum Britannicum*, an extensively annotated compilation of English alchemical works; an anonymous treatise collected by Ashmole described the alchemical plant as having a black root, red stalk, round leaves that "wexsyth and waynth as the Mon [moon] and flowers that shine".[58] His collection of alchemical recipes and secrets resembled the commonplace volumes he would have kept as a student, and may have been similar to collections of recipes kept by the Clarkes in their shop used to prepare medicaments. As Pugliano has indicated:

> Just as memorable and edifying passages were extracted from their context by students and scholars for further perusal, short paragraphs headed by the remedy's name and explaining its preparation might be copied into a notebook.[59]

Stukeley also indicated that, whilst at the Clarkes, Newton performed some experiments involving chemistry. He stated that:

> [Newton] invented the trick of a paper lanthorn with a candle in it, ty'd to the tail of a kite. this wonderfully affrighted all the neighboring inhabitants for some time, & caus'd not a little discourse on market days, among the country people, when over thir mugs of ale.

In his late teens, Newton owned the third edition of John Bate's *Mysteries of Nature and Art*,[60] which included recipes for fireworks and a firedrake, a kite to which lanterns could be attached.[61] Stukeley stated that episode was an "omen of the sublimity of Newton's discoverys", while John Conduitt stated that the kite construction led to natural philosophy, being the first instance of Newton's efforts to find "what body or curve would find the least resistance in a fluid".[62] And where did Newton get the materials to make his lanterns? The inventory of the Clarkes' shop indicates that with the usual groceries, mortars and pestles, and pan balances, they also carried a pound of "gone poweder" and gum arabic, used as a water-soluble binder in fireworks composition.[63]

The shop inventories also showed that they carried materials like red and white lead. The latter could be used in chemistry experiments, but these substances could also serve as the basis of artists' pigments. As art historian Elisabeth Berry-Drago has demonstrated, before art supply shops, illustrators would visit the apothecaries to procure materials, and there were intellectual connections between alchemical procedures and making pigments.[64] Minium or red lead (lead tetroxide) is a bright orange red pigment widely used for manuscript decoration and for painting. Lead white (native mineral is cerusite) is:

> a carbonate of lead which was in use since antiquity and was prepared from metallic lead and vinegar. It was the only white used in European easel paintings until the nineteenth century when its poisonous lead content restricted its manufacture and sale as an artists' pigment. Lead white is also the fastest drying of all of the whites because of the drying action of the lead pigment upon the oil.[65]

Stukeley noted that:

> Sir Isaac when a lad here at School, was not only expert at his mechanical tools, but equally so with his pen. for he busyed himself very much in drawing, which he took from his own inclination; & as in every thing else, improv'd it by a careful observation of nature. by this means our young artist furnishd his apartment with pictures of his own making. these pictures, & drawings he made frames for, himself, & color'd them over workman like[66]

In Newton's copy of John Bate's *The Mysteries of Nature and Art*, he took extensive notes on its section involving drawing and painting. He copied out that "a bras colour . . . is made of Masticot, & umber (massicot is a yellow pigment and umber a brown one); and also to make a colour for gold . . . umber, red lead and Masticot".[67] Although we have no direct evidence Newton was obtaining coloured pigments from the Clarkes for his painting, it seems the most likely explanation. By practising drawing and painting, Newton was developing the skilful hand and eye, honing his empirical observations of nature. As Alan Shapiro has shown, Newton "in a number of points" in his later writings "referred to painters, especially for their knowledge of harmonious combinations, and in the *Opticks*, he frequently used painters' powders in his experiments and observations".[68]

Conclusion

Apothecaries were often satirized for their treatments and their interest in the curiosities of nature. However, in his grammar school education and lodging with the Clarkes, Newton was extremely fortunate, his surroundings encouraging his intellectual development. When Newton matriculated at Trinity College, Cambridge, he would encounter a well-established (al)chemical culture, as the former master Alexander Akehurst (ejected 1654) had chemical furnaces in his chambers,[69] and Trinity College paid foreign chemists who tutored fellows in the subject.[70] His time in Grantham would have prepared him for such an atmosphere. Not only did he receive a solid classical education to prepare him for the rigors of Cambridge, but also his exposure to the art of the apothecary may have given him some practical skills and experiences, an embodied empiricism that would serve him well in his discoveries. For Newton, the world of learning and natural philosophy was clearly not "undreamed of in rural Lincolnshire".

Notes

[1] The biographies of Newton are almost too numerous to count, but for historiographic interpretations of his life and letters in the larger context of the history of science, see Rebecca Higgitt, *Recreating Newton: Newtonian Biography and the Making of Nineteenth-Century History of Science* (London: Pickering Chatto, 2007).

[2] See for instance, Lorraine Daston, "The Ideal and Reality of the Republic of Letters in the Enlightenment", *Science in Context* 4 (1991): 367–86;

Anne Goldgar, *Impolite Learning: Conduct and Community in the Republic of Letters 1680–1750* (New Haven and London: Yale University Press, 1995); Anna Marie Roos, "A Speculum of Chymical Practice: Isaac Newton, Martin Lister (1639–1712), and the Making of Telescopic Mirrors", *Notes and Records of the Royal Society* 64 (2010): 105.

[3] Richard Westfall, *Never at Rest: A Biography of Isaac Newton* (Cambridge: Cambridge University Press, 1983), 38.

[4] Larry Laudan, "Why was the Logic of Scientific Discovery Abandoned?", in *Scientific Discovery, Logic and Rationality,* ed. T. Nickles (Dordrecht: D. Reidel Publishing Company, 1980), 174, as quoted by Simon Schaffer, "Making Up Discovery", in *Dimensions of Creativity*, ed. Margaret A. Boden (Cambridge: MIT Press, 1996), 26.

[5] Schaffer, "Making Up Discovery", 15.

[6] 6John Manterfield, Newton's Grantham: The Hall Book and Life in a Puritan Town (Grantham: Grantham Civic Society, 2014), passim.

[7] John Manterfield, "Grantham Apothecaries—Further Notes", *Lincolnshire History and Archaeology* 25 (1990): 39–40.

[8] 8Steven Cherry, "Introduction", *International Journal of Regional and Local History* 2, no. 2 (2006): 5–6.

[9] Elizabeth Leedham-Green, *A Concise History of the University of Cambridge* (Cambridge: Cambridge University Press, 1996), 69.

[10] Brian Simon, "Leicestershire Schools, 1625–40", *British Journal of Educational Studies* 3 (1954): 46.

[11] Robert Burton, *Anatomy of Melancholy* (Plain Label Books, 1972), 468.

[12] T.H. Corfe, The School on the Hill: An Informal History of King Edward VII Grammar School Melton Mowbray, 1910–1960. (Melton Mowbray: by the author, 1960), 6.

[13] Dr John Manterfield and John Down, ed., *Grantham Corporation Hall Book,* 1649–50, f. 208v, online edition, accessed 22 February 2015, http://www.lincstothepast.com/exhibitions/places/newtons-grantham-and-the-hall-book-1649-1662/. This transcription forms part of a Heritage Lottery Funded project supported by South Kesteven District Council called Lincolnshire in the Age of Scientific Discovery; Professor Rob Iliffe of the Newton Project was the major research consultant (http://www.newtonproject.sussex.ac.uk).

[14] Manterfield and Down, ed., *Grantham Corporation Hall Book,* 1650–51, f. 227r, online edition, accessed 22 February 2015, http://www.lincstothepast.com/exhibitions/places/newtons-grantham-and-the-hall-book-1649-1662/.

[15] Corfe, *School*, 6.

[16] William Stukeley's memoir of Newton, sent to Richard Mead in four installments (26 June to 22 July 1727), each with a covering letter to Mead. MS Keynes 136 (part 3), f. 28, King's College Library, Cambridge. "The Newton Project", accessed 15 June 2014, http://www.newtonproject.sussex.ac.uk/view/texts/normalized/OTHE00001.

[17] For the influence of notebook culture on early modern science, see Richard Yeo, *Notebooks, English Virtuosi, and Early Modern Science* (Chicago and London: University of Chicago Press, 2014). Ann Blair, *Too Much to Know: Managing Scholarly Information before the Modern Age* (New Haven, CT: Yale University Press, 2010), 96 (on Gesner); Christoph Hoffmann, "The Pocket-Schedule: Note-Taking as a Research Technique", in *Reworking the Bench: Research Notebooks in the History of Science*, ed. Frederic L. Holmes, Jürgen Renn, and Hans-Jörg Rheinberger (Dordrecht: Kluwer, 2003), 183–202; Lorraine Daston, "Taking Note(s)", *Isis* 95 (2004): 443–48; and Staffan Müller-Wille and Isabelle Charmantier, "Natural History and Information Overload: The Case of Linnaeus", *Studies in History and Philosophy of Biological and Biomedical Sciences* 43 (2012): 4–15.

[18] Keith Thomas, *Rule and Misrule in the Schools of Early Modern England* (Reading: University of Reading, 1976), 4.

[19] Walter Ong, "Latin Language Study as a Renaissance Puberty Rite", *Studies in Philology* 56 (1959): 103.

[20] James Gleick, *Isaac Newton* (New York: Vintage, 2004), 34.

[21] Gleick, *Newton*, 34.

[22] Isaac Newton, Fitzwilliam Notebook, 3v. University of Cambridge. "The Newton Project", accessed 22 February 2015, http://www.newtonproject.sussex.ac.uk/view/texts/normalized/ALCH00069.

[23] William Stukeley's memoir of Newton, sent to Richard Mead in four installments (26 June to 22 July 1727), each with a covering letter to Mead. MS Keynes 136 (part 3), f. 32r, King's College Library, Cambridge. "The Newton Project", accessed 15 June 2014, http://www.newtonproject.sussex.ac.uk/view/texts/normalized/OTHE00001.

[24] Manterfield, "Grantham Apothecaries—Further Notes", 39–40.

[25] Lincolnshire Archives, L.C.C. Admon 1605/63. There are no folio numbers, as the inventories consist of long strips of paper sewn together.

[26] Stukeley's memoir of Newton, ff. 19–21r. "The Newton Project", accessed 15 June 2014, http://www.newtonproject.sussex.ac.uk/view/texts/normalized/OTHE00001.

[27] Stukeley's memoir of Newton, "The Newton Project", accessed 15 June 2014, http://www.

newtonproject.sussex.ac.uk/view/texts/normalized/OTHE00001.

[28] P. Broughton, "Arthur Storer of Maryland—his Astronomical Work and his Family Ties with Newton", *Journal for the History of Astronomy* 19 (1998), 77–96, on p. 79; John Venn and J.A. Venn, *Alumni cantabrigiensis* (Cambridge: Cambridge University Press, 1921–54), I.i.344.

[29] Manterfield and Down, ed, *Grantham Corporation Hall Book*, 1661–2, fol 365r, online edition, accessed 22 February 2015, http://www.lincstothepast.com/exhibitions/places/newtons-grantham-and-the-hall-book-1649-1662. See also S.J. Branson, *The King's School, Grantham—660 years of a Grammar School* (Gloucester: by the author, 1988), 31–34.

[30] Stukeley's memoir of Newton. "The Newton Project", accessed 15 June 2014, http://www.newtonproject.sussex.ac.uk/view/texts/normalized/OTHE00001.

[31] J.E. Power, "Henry More and Isaac Newton on Absolute Space", Journal of the History of Ideas 31 (1970): 289–96; Edward Grant, Much Ado About Nothing: Theories of Space and Vacuum from the Middle Ages to the Scientific Revolution (Cambridge: Cambridge University Press, 1981), 238–47.

[32] Patrick Wallis, "Consumption, Retailing and Medicine in Early-Modern London", *The Economic History Review* 61 (2008): 32.

[33] Manterfield, "Grantham Apothecaries—Further Notes", 39; L.C.C. Admons 1596/46, 28 January 1607, Lincolnshire County Archives.

[34] L.C.C. Admons 1596/46, 28 January 1607, Lincolnshire County Archives; L.C.C. Admons 1582/109 21 January 1583.

[35] Wallis, "Consumption, Retailing and Medicine in Early-Modern London", 33.

[36] Wallis, "Consumption, Retailing and Medicine in Early-Modern London", 32.

[37] Wallis, "Consumption, Retailing and Medicine in Early-Modern London", 37.

[38] L.C.C. Admons 1605/63, Lincolnshire Archives.

[39] Andrew Duncan, *The Edinburgh New Dispensatory* (Edinburgh: Bell and Bradfute, 1830), 1026. This is a traditional recipe for mercurial pills that was virtually unchanged over the centuries.

[40] For instance: "ye same liquor viz oyle of Vitriol) powred into a lixivium in wch crude |a|ntimony has beene newly boyled turnes it from a cleare to \a/ yellow colour, wch sec: 32 turned a yellow to a cleare one" (Isaac Newton, "Trinity College Notebook (MSS Add 03996)", fol. 135, Cambridge Digital Library, accessed 20 December 2013, 15 February 2015, http://cudl.lib.cam.ac.uk/view/MS-ADD-03996/273). The recipes for "metall for reflections" are on fol. 111v.

[41] Valentina Pugliano, "Specimen Lists: Artisanal Writing or Natural Historical Paperwork", *Isis* 103 (2012): 726.

[42] Harold Cook, "The New Philosophy and Medicine in Seventeenth-Century England", in *Reappraisals of the Scientific Revolution*, ed. David Lindberg and Cook and Robert S. Westman (Cambridge: Cambridge University Press, 1990), 414.

[43] For the relationship between apothecaries and medical students see Anna Marie Roos, "The Travel Journal of Dr Martin Lister", accessed 22 February 2015, http://listerstravels.modhist.ox.ac.uk.

[44] John Ray, Travels through the Low Countries: Germany, Italy and France... (London: J. Walthoe, 1738), 389.

[45] Wallis, "Consumption, Retailing and Medicine in Early-Modern London", 40; Robert Joseph Paton Williams, Allan Chapman, and John Shipley Rowlinson, *Chemistry at Oxford: A History from 1600 to 2005* (London: Royal Society of Chemistry, 2009), 29–30.

[46] See (*inter alia*): William R. Newman, "The Chymistry of Isaac Newton", Indiana University, http://webapp1.dlib.indiana.edu/newton/; Betty Jo Teeter Dobbs, *The Foundations of Newton's Alchemy: or 'The Hunting of the Greene Lyon'* (Cambridge: Cambridge University Press, 1975).

[47] Stukeley's memoir of Newton. "The Newton Project", accessed 15 June 2014, http://www.newtonproject.sussex.ac.uk/view/texts/normalized/OTHE00001.

[48] Stukeley's memoir of Newton. "The Newton Project", accessed 15 June 2014, http://www.newtonproject.sussex.ac.uk/view/texts/normalized/OTHE00001.

[49] Christian (Hamburg) Hünemörder, "Bean trefoil/-Buckbean", in *Brill's New Pauly,* ed. Hubert Cancik and Helmuth Schneider. Brill Online, accessed 22 February 2015, http://referenceworks.brillonline.com/entries/brill-s-new-pauly/bean-trefoil-buckbean-e218040. For an example of the misidentification of this plant, see John Gerard, *The Herbal: Or General History of Plants* (London: Adam Islip, Joice Norton and Richard Whitakers, 1633), sig. Aaaaaaa3.

[50] "Bogbean", Herbs 2000, accessed 22 February 2015, http://www.herbs2000.com/herbs/herbs_bogbean.htm.

[51] Nicholas Culpeper, *The Complete Herbal and English Physician Enlarged* (London: 1653; reprint Ware: Wordsworth,1995), 83.

[52] Brian Vickers, "On the Function of Analogy in the Occult", in *Hermeticism and the Renaissance: Intellectual History and the Occult in Early Modern Europe,* ed. Ingrid Merkel and Allen

G. Debus (Washington, D.C.: Folger Shakespeare Library; London: Associated University Presses, 1988), 265.

[53] Roger French suggests that beginning in the twelfth century, astronodial medical texts were written around the remark by Hippocrates that the physician "should look at the moon when it is full because the blood and the medulla increase and all things grow on earth and the sea increases" (Roger French, "Astrology in medical practice", in *Practical Medicine from Salerno to the Black Death,* ed. Luis García-Ballester, Roger French, Jon Arrizabalaga, and Andrew Cunningham (Cambridge: Cambridge University Press, 1994), 39.

[54] Anna Marie Roos, "Luminaries in Medicine: Richard Mead, James Gibbs, and Solar and Lunar Effects on the Human Body in Early Modern England", *Bulletin of the History of Medicine* 74 (2000): 433–57.

[55] Specifically, Galen believed that the influence of the moon and its effects on the periodicity of epileptic attacks depended on the "great or smaller share [of light] it received from the sun"; the moon's effects were weak at half moon, but strong at full moon (Galen, *De diebus decretoris,* in *Claudii Galeni Opera Omnia,* 20 vols., ed. C.G. Kuhn (Leipzig: Reprografischer Nachdruck der Ausg. Leipzig, 1821–33; Hildesheim: Olms, 1964–65), 9: 903. Oswei Temkin mentions that "Antyllus, an older contemporary of Galen, wrote . . . the moon rather moistens [the bodies]. And for this reason it makes the brain relatively liquid and the flesh putrid and renders the bodies of people who live in a clear cold air moist and dull and, for the same reason, stirs up heaviness in the head and epilepsies" O. Temkin, *The Falling Sickness: A History of Epilepsy from the Greeks to the Beginnings of Modern Neurology* (Baltimore: Johns Hopkins Press, 1971), 26.

[56] Anna Marie Roos, "The Chymistry of the 'Learned Dr Plot' (1640–96)", *Osiris* 29 (2014): 83.

[57] "Keynes MS. 30/5, King's College Library, Cambridge University", *The Chymistry of Isaac Newton*, accessed 22 February 2015, http://purl.dlib.indiana.edu/iudl/newton/ALCH00202.

[58] Elias Ashmole, *Theatrum Britannicum* (London: J. Grismond, 1652), 348–9.

[59] Pugliano, "Specimen Lists", 726.

[60] John Bate, *Mysteries of Nature and Art* (London: 1654).

[61] Simon Werret, *Fireworks: Pyrotechnic Arts and Sciences in European History* (Chicago: University of Chicago Press, 2010), 57. E.N. da Costa Andrade, "Newton's Early Notebook", *Nature* 135 (1935): 360.

[62] Werrett, *Fireworks*, 57; John Conduitt, "Account of Newton's life before going to University", Keynes MS 130.02, f. 23, King's College, Cambridge.

[63] Lincolnshire Records Office, L.C.C. Admon. 1582/109.

[64] "Elizabeth Berry Drago", Chemical Heritage Foundation, accessed 22 February 2015, http://www.chemheritage.org/about/contact-us/staff-and-scholars/beckman-center-for-the-history-of-chemistry/elisabeth-berry-drago.aspx.

[65] Michael Douma, "Lead White", Pigments through the Ages, accessed 7 June 2014, http://www.webexhibits.org/pigments/indiv/overview/leadwhite.html.

[66] Stukeley's memoir of Newton, "The Newton Project", accessed 15 June 2014, http://www.newtonproject.sussex.ac.uk/view/texts/normalized/OTHE00001.

[67] David Eugene Smith, "Two Unpublished Documents of Sir Isaac Newton", in *Isaac Newton, 1642–1727: A Memorial Volume Edited for the Mathematical Association,* ed. W.J. Greenstreet (London: G. Bell, 1927), 20–21.

[68] Alan Shapiro, "Artists' Colors and Newton's Colors", *Isis* 85 (1994): 620.

[69] The Hartlib Papers, Ephemerides 1653, MS 28/2/53A, The Hartlib Papers online, University of Sheffield, accessed 14 March 2014, http://www.hrionline.ac.uk/hartlib/; Anna Marie Roos, "The Chymistry of Francis Willughby (1635–72): *The Trinity College, Cambridge Community*", in *Virtuoso by Nature: The Scientific Worlds of Francis Willughby*, ed. Tim Birkhead (Leiden: Brill, 2015), forthcoming.

12 Notes on contributor

Correspondence to: Anna Marie Roos. Email: aroos@lincoln.ac.uk

Authors Queries

Journal: **International Journal of Regional and Local History**
Paper: **JRL18**
Title: **Newton and the Apothecary**

Dear Author
During the preparation of your manuscript for publication, the questions listed below have arisen. Please attend to these matters and return this form with your proof. Many thanks for your assistance

Query Reference	Query	Remarks
1	Please confirm this is the correct location for closing parenthesis.	
2	Should this be Katharine not Katherine and Storer not Storey.	
3	Please confirm if this spelling of Cambridge is an error in the original.	
4	Please confirm if deletion of repetition of "in the balance" is okay, to restore humoral balance should be sufficient.	
5	Please clarify this sentence, dis the wine induce vomiting?	
6	Please confirm if this spelling of knowledge is an error in the original.	
7	Please provide end note 70 text.	
8	Please provide publisher location.	

9	Please confirm the correct accessed date for inclusion.	
10	Please provide accessed date.	
11	Please check this page reference is correct.	
12	Please provide short author biography.	